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THE IMPORTANCE OF CHEMICAL FINISHING IN
INCREASING THE CONSUMPTION OF COTTON TEXTILES

An address by Walter M. Scott, Chief, Cotton Chemical Finishing Division, Utilization of Farm Products Southern Regional Laboratory, Bureau of Agricultural Chemistry and Engineering, United States Department of Agriculture, before the Southern Agricultural Workers' Association, Birmingham, Alabama, Feb. 7, 1940.

You have just listened to a paper by Mr. Cheatham dealing with the domestic utilization of cotton in which he emphasized, among other things, the importance of chemical finishes in maintaining and extending the use of cotton in clothing and household fabrics. Statistics show that about 60% of our domestic consumption of cotton is accounted for by these two types of fabrics, so that significant increases or decreases in the amount of cotton used on the person or in the home would have a marked effect upon the consumption of cotton as a whole.

The chief factor which governs the purchasing of fabrics for personal or household use is attractiveness or sales appeal, although increasing emphasis has been placed upon durability during the last few years. The ladies in this audience will realize the truth of this statement if they ask themselves just how they go about the selection of material for a dress or for draperies in their homes. I am confident that in the great majority of cases they are attracted to a certain piece of cloth first by its looks and second by its feel. They may inquire about its washability or general serviceability but quite often, although told that there is no guarantee as to these qualities, they decide to take it anyway because its style appeals to them.

This is the principal reason why cotton has been gradually replaced by rayon in the manufacture of certain clothing and household fabrics. Rayon fabrics are made from chemical fibers and the producers of these fibers, who are chemically minded, have not hesitated to alter their processes in order to obtain fibers and fabrics which conform more closely to the popular demand. For example, when rayon goods were first produced they had a high luster which was objectionable to most consumers. After some years of research, the rayon manufacturers eliminated this drawback by incorporating a finely divided white pigment in the spinning solution, so that the resultant yarn lost its excessive luster and became whiter and much more attractive in appearance.

On the other hand, cotton is a natural fiber and for many years there has appeared to be considerable hesitancy about changing the outward appearance which had been bestowed upon it by nature. However, modern women do not hesitate to use chemicals in an effort to improve the faces with which they came into this world, and so the modern cotton textile manufacturer should not be backward in using chemicals to enhance the beauty and usefulness of his natural raw material.

A specific illustration of the trend from cotton toward rayon came to my attention a short time ago when visiting one of the larger textile mills in the South. I was told that this mill used to produce about 4,000,000 yards

per week of white cotton nainsook which was largely used for infants' clothing and for ladies' underwear. At the present time their production of this type of goods has dropped to about 600,000 yards per week, which is only 15% of their former output. They stated that this decline in the consumption of domestic white nainsook was chiefly due to competition by rayon although it was to some extent affected by the importation of cheap Japanese cotton cloth.

A few of the larger cotton manufacturers have established chemical research departments which have conducted some research with a view to opening up new markets for cotton and regaining certain markets which have been lost to competing products. However, very few mills are financially able to support a continuing research program, and the industry as a whole is so diversified and so highly competitive that cooperative research among cotton manufacturers appears to be difficult and in fact almost impossible to obtain.

Furthermore, some of the cotton manufacturers are discouraged by the results of their own research. Several of them have told me that they spent considerable time and money in developing new types of finishes for certain of their fabrics. These new finishes were admittedly superior to the old ones, but they cost a little more to produce and hence the resultant fabrics had to be sold at a slightly higher price. The wholesalers or the garment manufacturers, through whom all of their production was sold, refused to pay the premium for the better finish because they did not think that they could pass this increase in price on to the ultimate consumer. Hence, the manufacturers were unable to capitalize upon the results of their research.

Up to now, I have painted the dark side of the picture, but there is a bright side which I will endeavor to show in the remainder of this paper. Research on cotton fabrics can be made to pay and the public can be educated to demand that the results of such research be made available to them. A classic example of this is the case of pre-shrunk cotton fabrics. The idea of pre-shrinking is not new; in fact, I know cotton manufacturers who were pre-shrinking some of their fabrics at least 20 or 25 years ago. Here again, the wholesalers refused in many cases to pay the extra price for pre-shrunk fabrics.

However, a certain firm developed a special machine and a special procedure by which it was possible to establish accurate control of the shrinkage in finishing and to place cotton goods on the market which could be guaranteed to have practically no residual shrinkage. This process was called "Sanforizing." This concern, in order to break down the sales resistance of the middleman, put on a campaign of national advertising directly to the consumer. The results were astonishing. Practically all of the goods for men's shirtings are now pre-shrunk and even the relatively low-paid gas station attendants and garage mechanics are demanding Sanforized cotton overalls and uniforms, so that they can buy them to fit and not be troubled by shrinkage after washing. I have been told that these men are willing to pay 98¢ for a pair of Sanforized overalls whereas they would only have to pay 78¢ for ordinary overalls of the same material. Naturally in the face of such a demand, the wholesalers are willing to pay the higher prices required by the manufacturers, with the result that one mill which I recently visited was running 16 Sanforizing machines day and night, almost entirely on cloth intended for men's work clothing.

This is an example of one property of cotton which was improved as a result of research. I will now briefly discuss several other properties which

chemical finishing processes can be expected to impart to cotton textiles, or to improve where they already exist.

One of the most important of these properties is luster. For many years the process of mercerization has been practiced in the cotton industry and it is common knowledge that mercerized cotton has, in general, a moderate increase in luster over unmercerized cotton. Still higher increases in luster have been obtained mechanically by "schreinerizing" or some other form of calendering, where the cotton cloth is subjected to high pressure between heated rolls. Glazed chintzes and high luster sateen lining fabrics are produced in this manner, but the luster is not permanent and entirely disappears if the goods are washed. Recent studies have indicated that a permanent glazed chintz or other high luster cotton goods can be produced by impregnating the fabric with one of the clear colorless synthetic resins, such as have been utilized as the liner in safety glass. A small number of fabrics treated in this manner have already been placed on the market but much research is required before the possibilities can be fully exploited.

Another property demanded in some types of cotton fabrics is softness. This is particularly true in women's dress goods and underwear. Softness in the past has been imparted to cotton textiles by finishing them in a bath containing Turkey red oil or a similar soluble oil. This, however, was only a temporary softness which was lost after the first washing. Lately it has been discovered that certain organic compounds, which are described chemically as "cation-active", have the property of imparting to cotton a permanent softness which is not removed by many washings. This opens up a new field of finishing research.

The opposite of softness, namely stiffness or crispness, is desired in other types of cotton fabrics, such as hospital uniforms or aprons. This property has customarily been imparted to cotton goods by starching. It is possible to obtain satisfactory stiffness with starch but this method is open to the objection that it has to be repeated after every wash. Recent preliminary experiments have indicated that certain cellulose ethers, and other synthetic thermoplastic materials, can be utilized to impart any desired degree of stiffness to cotton fabrics, which can be restored after each washing simply by pressing with a moderately hot iron. Further studies along this line are projected.

The question of waterproofness is becoming increasingly important in connection with many varieties of cotton fabrics. The ability to shed water has always been recognized as an essential for heavy cotton duck or canvas which was to be used for tents, tarpaulins, etc. Now, however, more and more emphasis is laid on the desirability of a reasonable resistance to water in cotton gabardines and jeans which are used for uniforms for gas station attendants, and it is also recognized as an asset for women's dress goods so that they will not be adversely affected by exposure to an unexpected shower. Resistance to wetting has generally been imparted to cotton goods by depositing in or on the surface of the fibers a metallic soap such as aluminum stearate or a film of wax. The resultant finishes were not able to survive even a moderate amount of washing. Modern research has again pointed the way to one

or more solutions for this problem. For example, if the wax is applied in connection with a synthetic plastic which is compatible with it, the binding action of the plastic tends to hold the wax on the cotton through a number of washings. Or, as an alternative, it has been found that certain new organic compounds will actually react with cotton to give it the ability to resist wetting throughout the entire life of the fabric.

Other properties which chemical finishing is capable of imparting to cotton textiles, will be briefly mentioned at this point. Cotton draperies may be treated so that they are fire-resistant and will not burn when exposed to a flame. Cotton upholstery fabrics may be made spot-proof so that liquids spilled on them may be removed by wiping with a damp rag, just as in the case of oilcloth. Cotton duck and canvas may be treated so that they will not show any traces of mildew, even when stored for a long time in a damp place. It may even be possible to treat cotton socks or the linings for shoes so that they will not act as carriers for the famous, or shall we say infamous ring-worm, known as athlete's foot, which is so prevalent now-a-days.

The Cotton Chemical Finishing Division of the Southern Regional Research Laboratory is being organized and equipped to carry on the finishing research for which the cotton manufacturers as a whole are unable to provide. We recognize that a certain amount of research along this line is being done in the laboratories of those chemical firms who manufacture specialties for the textile trade. However, such research is handicapped by the fact that each manufacturer is naturally biased in favor of his own products, and the results of his research are usually made available only to his own customers.

In the Southern Laboratory, a special section of the finishing division will devote its time to the study of additive finishes for cotton. It will make a complete survey of the synthetic plastics and other organic compounds which are now available to the cotton industry, and determine which are most suitable for producing the various effects described earlier in this paper. Attention will also be paid to the development of suitable procedures by which such compounds can be satisfactorily and economically applied to cotton goods on a commercial scale. Furthermore, as a result of our experience with existing compounds, studies will be undertaken for the purpose of developing new compounds which will be still more efficient in producing the desired effects on cotton.

Another section will devote its time to the study of chemical reactions on the cotton itself, with a view to modifying the surface characteristics of the cotton fiber by actual chemical change. That this is not beyond the realm of possibility has been demonstrated by previous accomplishments along this line. Mercerization, mentioned earlier in this paper, is a form of chemical action on cotton, with caustic soda as the agent. A solution of copper and ammonia has been used to impart a particularly lustrous and crisp finish on cotton voiles and lawns. This is known commercially as the Furness process or, more recently, the Ridbo process. Strong sulfuric acid is known to be capable of producing a linenized effect on cotton damasks. It is therefore quite conceivable that other chemical agents may be found which will produce still more desirable effects on cotton.

Finally, it is our conception that the big national problem of increasing the utilization of cotton in wearing apparel and household fabrics goes beyond the development in the laboratory of new and attractive finishes for cotton fabrics. Another definite part of our program is to carry each successful laboratory development to the point of demonstrating its commercial practicability. And then, to complete the job, these new finishes must enter into actual commercial usage. You will realize that all of this entails cooperation of the broadest type.

We need, first, the cooperation of cotton manufacturers and finishing plants, for they are the ones who will use the finishes. We are enthusiastic about the cooperation received so far from those people in the planning of our work. I have recently visited ten representative cotton mills in the South, scattered through Alabama, Georgia, South Carolina, North Carolina and Virginia, among them some of the largest finishing plants in the country. The executives in all of these organizations gave me a very cordial reception and indicated a willingness to cooperate in every way possible.

However, in order to fully capitalize upon the results of our work, it is necessary to go even beyond the step of convincing the manufacturers of the commercial practicability of these finishes. I have pointed out earlier in this paper that in some instances the cotton processors have developed new finishes for their fabrics which they considered superior to anything previously offered on the market. And yet the ultimate consumer has never seen these finishes because the middleman did not consider it good business to pay a slightly higher price for them.

So, the further problem is to use every worthwhile means of acquainting ultimate consumers with the new developments. I do not mean by high-pressure advertising, but by giving the true facts to as many consumers as possible and showing them what they may expect from the new finishes. For this purpose, we need cooperation from home economic groups, women's clubs and other organizations like your own. If a sufficient consumer demand is aroused for cotton goods with a certain new and attractive finish, there will be no difficulty in persuading the wholesaler to purchase and the manufacturer to produce such goods in any desired quantity.

In conclusion, then, I wish to emphasize again that the mission of the Cotton Chemical Finishing Division is to develop in the laboratory new and attractive finishes for cotton textiles, to demonstrate to the cotton mills that these finishes can be successfully applied on a commercial scale and to cooperate with all those organizations who are interested in acquainting the ultimate consumer with the value of these finishes. Thus the basic function of the Southern Regional Research Laboratory will be performed - namely, the stimulation of a larger use of cotton, the South's chief agricultural product.

